Vibration Isolation System and Microgravity Assessment of Centrifuge

Centrifuge is used by the current scientist and crew member to run different tests. It is perfect for serology, coagulation, clinical chemistry and more. The current centrifuge on orbit as it is called Refrigerated Centrifuge (RC) has been at ISS for approximately ten years. The flight hardware and software development team within the ISSMP directorate was tasked in designing and retrofitting commercial centrifuge that will replace the RC. The newer centrifuge will be COTS (commercially off the shelf) product designed to address RC imbalance detection and general operational challenges. It will be prototyped and tested to meet technical and design requirements. Specific problem crew members and PI team were having is imperfect sample separation. This was speculated as results of fixed angle tube placement or rotor vibration. The newer centrifuge will have swing bucket so tube samples will be at complete 180 degree when spinning giving them better advantage to rotational force dynamics. The second challenge is as system requirement, prototype has to pass vibration and microgravity requirements for payloads and the structure it will be supported by which is the EXPRESS rack.

My task was in characterization of power requirements, imbalance detection and vibration response of the newer and older centrifuge models. The main objective of the vibration study is to meet requirement during launch and in microgravity operation on the newer model as per requirements for all flight hardware. At the end of the vibration study, this project hope to answer the two initial problem of this project. The imbalance detection issue where due to human error more samples are inserted into the test tubes inducing more vibration within the hardware and to the rack system. Prototype was tested when higher mass samples are introduced until it generates an imbalance. Vibration data will be analyzed to understand mass imbalance effect on the centrifuge and on to the EXPRESS rack. The second one is to select the best vibration isolator based on test analysis where during operation the hardware vibration transmission to rack will be minimal or meet the structural requirements. Test set up were performed in a way where all hardware operation scenario were used. To understand how much of vibration force the hardware was receiving, hardware was tested by itself mounted with different vibration isolator selection with different mass imbalance. To understand how much vibration the hardware it was transmitting to the rack with different mass imbalance.

- Assessment of different vibration isolators
- Based on vibration data and analysis select isolators to be used
- Addressing imbalance detection and its effect on vibration
- Collect and compare vibration data between prototype with selected isolator to the current controlled class 1E RC

My responsibilities were to perform the above task list in collaboration with other hardware engineers. Once the test was performed, data was carefully analyzed to make a decision on best-fitted vibration isolators. The vibration data collected will be compared with the benchmark structure and microgravity requirement by NASA for EXPRESS rack and payloads.

In addition to this, my responsibilities at NASA JSC were to understand the product development progression including reviewing, testing, operating and sustaining process. This products are flight hardware supporting the different science experiments and ongoing medical research effort. In addition, I was able to learn how each engineer and scientist(PI) within the different JSC organization communicate to finish a product and the management, scheduling and testing logistics that is put in place for a single project. I had the opportunity of seeing the team dynamics and inner functioning between NASA and contractors team. Some of the side project I had a chance working on were,

- Sustaining engineering and ground servicing of the Holter monitor and ultrasound 2 and Vein Press
  - Process of developing and working with NASA benchmark Task Performance Sheet (TPS) for class 1 and class 1E hardware
- Flight hardware testing and verification
  - Electromagnetic Interference (EMI) testing and verification of Spectrometer (light meter) for lighting effect
  - Thermal testing and workmanship verification of light meter using Thermotron for flight certification
- Engineering evaluation of Spectrometer in the lighting and optics lab
- Developed software procedural document for the XSENS Force Shoe ARED (Advanced Resistive Exercise Device)